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Study Of Assignment Problem In Sports And It's Applications

Research proposal submitted in partial fulfillment of registration to Ph.D.Program

DOCTOR OF PHILOSOPHY

In The Subject

Mathematics

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1) Introduction to proposed research topic:-

Assignment problem is degenerated form of transportation problem. Assignment problem ,transportation problem are type of linear programming problem. Problems related to assignment have many applications such as transportation, healthcare, education, seating arrangement, business, sports etc[10]. Assignment problem deals with allocation of varies resources to varies activities on one to one correspondence. Assignment problem have two types

a) Balanced Assignment Problem :- n objects are related to n another objects
b) Unbalanced Assignment Problem:- n objects are related to m another objects.

Definition and Mathematical Formulation of general assignment problem :

The general aim of Assignment problem is to optimize the allocation of resources to demand points where both resources and demand point share equal number. Therefore assignment problem can be presented as :

Optimize

$$\sum_{i=1}^{n}\sum_{j=1}^{n} c_{ij}\ x_{ij} \qquad \text{.....(1)}$$

Subject to

$$\sum_{j=1}^{n} x_{ij} = 1 \qquad i=1,2,3\ldots,n \qquad \text{.....(2)}$$

$$\sum_{i=1}^{n} x_{ij} = 1 \qquad j=1,2,3\ldots n \qquad \text{.....(3)}$$

x_{ij} = 0 or 1, i=1,2,…n j=1,2…n ……..…(4)

Where c_{ij} is the cost or effectiveness of assignment i^{th}resource to j^{th} demand, x_{ij} is 0 or 1 as presented in equation (4) and n is number of resources or demands. The constraints of problem are defined as equation (2) and (3). Equation (2) indicates that each resource i needs to be

assigned to one demand j, while(3) show that each demand j needs to be assigned to only one resource i.[2]

Solution method :-

The assignment problem can be solved by the following four methods :

1) Enumeration Method
2) Simplex Method
3) Trasportation Method
4) Hungarian Method

Now a days mathematicians found new techniques to solve assignment problem which are as follows :

- Heuristics algorithm
    1) Constructed method
    2) Limited enumeration method
    3) Improvement method
    4) Simulated annealing technique
    5) Genetic algorithms

- Metaheuristic algorithm
    1) Local search algorithm
    2) Population search algorithm

- Hybrid Method

- Exact Method
    1) Dynamic Programming
    2) Integer Programming

3) Linear Programming

- Branch and Bound Method

Heuristic and metaheuristic algorithms are used when problem becomes too large for exact method. Exact method is complicated than heuristic method. Exact method give solution of large scale problem instances in manageable times. Genetic algorithm is used more than other method to solve assignment problem. Currently many mathematicians evaluate assignment problem by using various techniques such as Fuzzy logic, Machine learning, genetic algorithm, MATLAB programming. Currently Mathematicians also works on quadratic assignment problem.

1) Quadratic Assignment Problem(QAP) : Quadratic assignment problem was introducedbyKoopmans and Beckmann in 1957. QAP is one of the fundamental combinatorial optimization problem. QAP has many applications in real life such as scheduling, production, computer manufacture, chemistry, facility location, communication and other field[2].

2) Assignment problem by genetic algorithm: Genetic algorithms are a class of algorithms designed to explore a large search space and finite optimal solutions by mimicking evolution and natural selection. In a genetic algorithm three operators are apply on population of string (called chromosomes or the genotypeof the genome) to approach better solution. This three operators are 1) Cross-over 2) Mutation 3) Selection[3]

3)FuzzyAssignment Problem (FAP): Fuzzy logic is a form of many-valued logic in which the truth values of variables may be any real number between o and 1. It is employed to handle the concept of partial truth. Hungarian method is used to solve FAP by using ranking function for fuzzy costs.

4) Assignment problem by using machine learning: Over the last few year use of machine learning in various field is popular and also necessary.Machine learning(ML) is the study of computer algorithms that can improve automatically through experience and by the use of data. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning.

2) Review of literature :

H.W.Kuhn[1955] developed Hungarian method for Assignment Problem. He also derived mathematical formulation and Hungarian algorithm for Assignment Problem.

EL Lawler[1963]In this paper Lawler presents formulation of the Quadratic Assignment Problem of which the Koopmens-Beckmann formulation in special case. Here lower bound on cost function is discussed.

PC Chu, JE Beasley[1997]able to find optimal and near optimal solution that are on average less than 0.01% from optimality of Assignment Problem by using genetic algorithm.

Yosef Sheffi, Warren B Powell[1982] shows that with random link times we can find solution of generalized assignment problem by using Branch and price algorithm. The paper shows the equivalency between the first order conditions as well as the uniqueness of the solution. This paper also describes an algorithm approach to the solution of program including a proof of convergence.

Ibrahim H Osman[1995]use Heuristics method for the generalized assignment problem with Tabu search approaches. Aλ-generation mechanism is introduced. The developed method proven useful for obtaining optimal solution.

Sathi Mukherjee and Kajla Basu[2010]used Yager's ranking method for ranking the fuzzy numbers. The fuzzy assignment problem has been transformed into crisp assignment problem in the LPP from and solved by using LINGO 9.0.

Dr.Kirtiwant Ghadle,Yogesh Muley[2013]gives Revised Ones Assignment Method for solving assignment problem. This method is same as Hungarian method. They also illustrate some examples based on Revised Ones Assignment Method.

SS Rao,M Shrinivas[2016]The purpose of this paper is to propose an effective algorithm to find the optimal solution of an assignment problem to reduce computational cost.They also gives some examples to illustrate the proposed algorithm.

3) Objectives of the Research Study:

1) To propose algorithm to solve assignment problem in easiest way in short period of time.
2) To develop new mathematical model of Assignment Problem.
3) To study Quadratic Assignment Problem as well as Genetic Assignment Problem.
4) To study assignment problem by using Machine Learning.
5) Hence, in present work, I will be try to develop new results and new techniques for solving assignment problem.

4)ResearchMethodology:

The following steps will beincluding in the Methodology.

1) To refer therelevant books on Operation Research.
2) To study all methods for solution of Assignment Problem.
3) To understand latest research on assignment Problem.
4) Try to apply new methods and techniques to solve assignment problem.
5) Compare results using different methods of assignment problem.

5) Importance of study:

In Physics, Engineering and Economics Assignment Problem is becoming a valuable and important tool for solving complicated and complex problems. Study of assignment problem is important to minimize cost, maximize profit, saving of money as well as time.

- **International Status:** Many scientists and researcher many more contributed in the development of area of Assignment Problem. Some of them are Harold Kuhn,EL Lawler, Powell,Elsevier, Kilne,R Hill,BA Richards,S-Faudzi, S Abdul-Rahman, AF Porto, CG Lian, Y Yin, R Wang, SQ Liu, M Yoon, H Lee.
- **National Status:** Indian's also done remarkable work on Assignment Problem like MR Hasan,MH Alkinani,ZH Ahmed,PSKumar, D Patel, Z Narmawala, S Tanwar, PK Singh, SK Mohapatra, MN Mohanty, PR SinhaMahapatra, N Gupta, N Patel,MK Tiwari.
- **Regional Status:**Many Maharashtrian mathematicians are also involved in study of Assignment Problem like KP Ghadle, YM Muley,DA Munot,SK Prabha, S Vimala, V Aggrawal,VG Tikekar,V Potdar, S Jadhav,P Yadav.

6) Scope of research work:

Assignment problem has used in almost every field. Such as Engineering, Economics,Business, Physics and many more. Assignment problem finds applicability in various diverse business situations like assigning machines to factory order, assigning sales to sales territories, assigning accountants to of the clients. In last decade mathematicians done great work on assignment problem, its applications, different methodology to approach solution. Even so there is chance to research on application problem by using new techniquies. We try to use hybrid method, genetic algorithm to find solution of assignment problem. By using machine learning we check and compare solution of assignment problem.

7)Expected Outcomes:

- We will try to develop new method to solve assignment problem.
- We will try to work on quadratic assignment problem ,genetic assignment problem deeply to getting appropriate solution
- We will try to develop mathematical model.

8)Purpose of carrying out proposed research work:

The purpose of the research is to develop new method or make hybridization of two methods to solve problem. Our another purpose is to apply assignment problem on mathematical model and check the solution. We will compare the answers by using various methods.

9)Plan of work:

Sr. No.	**Period**	**Plan ofwork**	**Targets to be achieved**

1	First Year	Study of background information relevant to the research issue.	Excellent understanding of the subject and well organized course work.
2	Second Year	Collecting and analyzing research articles.	Attempt to obtain fresh results based on existing work.
3	Third Year	Work on some problems which I want to include in the thesis.	Submit atleast three Papers.
4	Fourth Year	Publishing some papers and submittingthe thesis.	Some more papers and Thesis submission.

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